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Publication Date
2009-07-01

Center of Evaluation for Global Action
Working Paper Series

Agriculture for Development
Paper No. AfD-0914
Issued in July 2009

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Series Description: The CEGA AfD Working Paper series contains papers presented at the May 2009 Conference on "Agriculture for Development in Sub-Saharan Africa," sponsored jointly by the African Economic Research Consortium (AERC) and CEGA.

Recommended Citation: Ndirangu, Lydia; Burger, Kees; Moll, Henk A.J.; Kuyvenhoven, Arie. (2009) Seasonality, precautionary savings and health uncertainty: Evidence from farm households in Central Kenya. CEGA Working Paper Series No. AfD-0914. Center of Evaluation for Global Action. University of California, Berkeley.

Seasonality, precautionary savings and health uncertainty: Evidence from farm households in Central Kenya

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Abstract

The high prevalence of risks in low income economies implies that people's ability to manage uncertainty is critical for both productivity and their mere survival. This paper analyses seasonal changes in per capita consumption and saving behaviour of farm households in response to health and weather shocks. The notion that people save most of there transitory income, as postulated by the permanent income hypothesis, and precautionary saving motives are tested using a sample of 196 households examined over three consecutive cropping seasons in Central Kenya.

The results show that, while people exhibit some level of prudence, the marginal propensity to save out of transitory income is about 33 percent — about a third of what the permanent income hypothesis postulates. This proportion saved is an indication of the extent of incompleteness of credit and insurance markets in the study area. This shows substantial scope for remedial public action in social protection programmes.

Seasonality was found to impact on propensity to save with more stressful seasons adversely affecting both savings and consumption. There were differentiated propensities to smooth consumption between the rich and the poor, with the latter group exhibiting stronger precautionary motives. However, the wealth effect becomes insignificant as the seasons worsen pointing to a vulnerable asset base.

Unlike weather uncertainty, consumption rise and savings decline in response to health stress associated with HIV/AIDS. The desire to smooth the health (asset) stock seems to outweigh the desire or ability to smooth future consumption through savings. The consequence is more volatile consumption for HIV/AIDS affected households.

Key words: Precautionary savings, HIV/AIDS, rainfall variability, farm households.

[1] The authors wish to acknowledge the financial support from the Dutch Government through the African Women Leaders in Agriculture and Environment (AWLAE) Program of Winrock International.

1. Introduction

People who live in low income economies often have to cope, not only with severe poverty, but also with extremely variable income. The implications of this income variability on consumption has been a central theme of much research in developing countries (e.g. Deaton, 1991; Paxson, 1993; Udry, 1994; 1995). However, income variability implies consumption variability only if households do not use mechanisms to insulate consumption from income fluctuations across periods. The bulk of the work providing most of the insights on consumption smoothing use weather as the major source of income variability (Czukas *et al.*, 1998; Dercon and Krishnan, 2000; Kinsey *et al.*, 1998; Paxson, 1993; Udry, 1994). While weather is an important source of risk in rain-fed agriculture, with the spread of HIV/AIDS, health uncertainties have increasingly become important (Lundberg *et al.*, 2003).

Deaton (1992) shows that in the absence of complete financial markets, prudent households may accumulate and draw down stocks of physical or financial assets to maintain consumption levels that vary slightly from time to time. The more variable the future income, the higher would be the incentive to save for a rainy (dry) day. It is thus expected that households that face greater uncertainties due to poor health and weather variability across seasons would have more precautionary savings and their portfolio of assets would also be more liquid.

The marginal propensity to save out of transitory income (MPS_T) is used as a measure for the saving response to shocks. The more MPS_T is to one, the more the households are able to use savings and credit market to insulate consumption against shocks i.e. the magnitude of MPS_T is an indicator of the degree of completeness of credit and insurance markets (Morduch, 1991), and thus of relevance for financial and social protection policies.

The study uses a three season's panel data generated from 196 households surveyed over 18 months. Although it is difficult to differentiate between the continuum of *ex ante* and *ex post* behaviour within the short season covered in the study, the study recognizes that household members are not passive to shocks and that people adapt to their new outcomes. The adaptation to current outcomes may entail reorganization of the assets and livelihoods, with an eye to the possibility of recurring episodes of negative events. The short-run seasonal effects may have long-term consequences for poverty (Dercon, 2005). Such effects also provide information on what kind of households are most sensitive to shocks.

The paper is organized as follows: Section 2 presents the data and empirical model of savings in the presence of fluctuations in income. Section 3 presents the results and section 4 concludes.

2. Data and the empirical approach

2.1 Data

Data used in this paper was collected from three household surveys carried out between May 2004 and April 2005 in Thika and Maragua districts in Central Kenya. The region has bimodal rainfall distribution and hence two planting seasons per year. The first survey captured information for the short cropping season (October to March) of 2003/2004. The second survey captured information for the main cropping season (April to September). The third survey collected information for the 2004/2005 short cropping season. The timing for each survey round was after the harvest season to capture each season’s income.

The average HIV prevalence in the two districts was 8.5 percent, which was above the national average of about 7 percent in 2003 (GOK, 2004). The quantitative survey data was complimented with qualitative information from community health workers, local health centers, people living with HIV/AIDS and community leaders. This extra information was used to confirm HIV/AIDS status wherever there was doubt. It was important that the HIV status categorization was correct, both for ethical reasons and for correct impact analysis. Due to the prevailing HIV/AIDS stigma, snowballing sampling technique was used to locate HIV/AIDS-affected households from randomly pre-sampled household clusters in the national sampling frame. Hereafter, these are referred to as AIDS-affected. In total, 196 households were interviewed in the three surveys, comprising 101 AIDS-affected and 95 non-affected.

The data set contains information on household expenditure, income, savings, value of assets, economic activities of all household members, farm specific crop and livestock shocks, regional rainfall shock; types of illnesses experienced by household members and working days lost due to illness.

On crop loss, data was collected on events in the past cropping season that could have affected crop and livestock production. An index similar to that of Dercon and Krishnan (2000) was constructed from the responses. The indices ranged from 1 to 4 depending on farmers perception of severity of loss (1 being least severe and 4 representing total loss). For the regional rainfall shock, this was calculated as percent rainfall deviation from a 14 year average precipitation for ten weather recording points in the study zone. Two critical seasons in the crop cycle were considered: the planting and the weeding seasons. The weeding season also captures the growth phase.

2.1 Empirical approach

Several methods have been used in the literature to investigate whether individuals make provision for the future. Deaton (1991), Udry (1995), Guiso *et al*. (1996) and Kochar (2004), all following Campbell (1987), test whether savings predict future changes in income. This paper adopts Paxson's (1992) approach who computes the marginal propensity to save out of transitory income. Savings is taken as a linear function of permanent income (Y_{it}^{P}), transitory income (Y_{it}^{T}), income variability (VAR_{it}) and a set of variables that measure the life-cycle stage of a household (LC_{it}). This is expressed as:

$$S_{it} = \alpha_o + \alpha_1 Y_{it}^{P} + \alpha_2 Y_{it}^{T} + \alpha_3 VAR_{it} + \alpha_4 LC_{it} + \varepsilon_{it} \quad (1)$$

where S_{it} is per capita saving for household i in season t, and ε_{it} is an error term. Empirical tests of the effect of α_3 on savings would show whether people with more uncertain income save more on average than those with more stable income streams. In the absence of panel data that would allow computation of income variability suitable for this analysis, we follow Paxson (1992) who combines cross-sectional household information and a set of variables that measure the variability of regional rainfall as the proxy for VAR. For livelihoods which are largely dependent on agriculture, more variable rainfall is likely to yield more variable incomes. Also included in VAR is a dummy for HIV/AIDS. In addition, the VAR variables are interacted with wealth as per Rosenzweig and Binswanger (1993) since wealth may influence precautionary behaviour.

The life-cycle factors in LC_{it} consist of variables that measure the number of household members in a number of age-sex categories. This includes 5 years and below, 6–14, 15–17, 18–64, and above 65. The life-cycle models suggest that households with greater numbers of young children and older members can be expected to save less, since their current labour income is less than the annuity value of their lifetime wealth. Furthermore, if parents rely on their children for support in old age, then expenditure on children may serve as a substitute for savings, implying that households with more children may save even less. However, the presence of HIV/AIDS implies shorter lifespan for parents. How this impacts on savings behaviour is an empirical issue. For instance, while the need to meet immediate medical expenses may mean liquidation of assets, the need to leave stable income streams for children may lead to an increase in desire to maintain or acquire productive or more durable assets.

One thing needs to be noted: the analysis of precautionary savings as described in (Deaton, 1997 pg.361) assumes that although future consumption becomes more uncertain, in that the spread around the mean becomes larger, its mean remains constant. With HIV and AIDS, this assumption may easily be violated in that, mean consumption can change with time as medical and food consumption needs change. However, given the short period covered by the study, we assume that household mean consumption is preserved.

Estimation of permanent and transitory incomes

Permanent income is defined over a short time horizon as expected income for season t conditional on the resources and information available at the beginning of the season. To estimate the permanent component of income, the following equation is specified:

$$Y_{it}^{P} = \beta_{t}^{P} + \beta_{1} VD + \beta^{P} X_{it}^{P} + u_{it}^{P} \qquad (2)$$

where X_{it}^{P} represents a vector of household-fixed variables that are determinants of permanent income. This includes age, education and sex of household members; and ownership of physical assets. More education is expected to make people less myopic and hence save more. Households with more females are expected to have a different saving behaviour (Jianakoplos and Barnasek, 1998; Quisumbing and Maluccio, 2000). VD are village dummies, β_{t}^{P} is a seasons effect common to all households and u_{it}^{P} is a random error term with zero mean.

The transitory income is expressed as:

$$Y_{it}^{T} = \beta_{t}^{T} + \beta^{T} X_{it}^{T} + u_{it}^{T} \qquad (3)$$

where X_{it}^{T} is a set of variables that affect transitory income. We include percent rainfall deviation, the qualitative index of crop loss; the number of work days lost by male and female spouses due to ill health and the latter interacted with the HIV/AIDS dummy. Interaction of ill days with the HIV/AIDS dummy helps differentiate effects of AIDS-related illnesses from other illnesses. Paxson (1992) did not have information on household-specific variables of transitory income. The effect of household-specific shocks on savings was therefore included in the error term u_{it}^{T}. β_{t}^{T} is a season's effect common to all households.

Equations (2) and (3) are combined to form an equation for total income as:

$$Y_{it} = \beta_{0t} + \beta_1 VD + \beta^{P} X_{it}^{P} + \beta^{T} X_{it}^{T} + \mu_{it} \quad (4)$$

where $\beta_{0t} = \beta_t^{P} + \beta_t^{T}$. Equations (2) and (3) can also be substituted into the structural savings equation (1):

$$S_{it} = \rho_{0t} + \rho_1 VD + \rho_P X_{it}^{P} + \rho_T X_{it}^{T} + \alpha_3 VAR_{it} + \alpha_4 LC_{it} + \varepsilon_{it} \quad (5)$$

where $\rho_1 = \alpha_1\beta_1 \qquad \rho_{0t} = \alpha_{ot} + \alpha_1\beta_t^{P} + \alpha_2\beta_t^{T}$; $\rho_P = \alpha_1\beta^{P}$; $\rho_T = \alpha_2\beta^{T}$

Noting that the variables in LC_{it} and VAR_{it} are collinear with X_{it}^{P}, a reduced form of the savings equation can be written as a function of the X's :

$$S_{it} = \gamma_{it} + \gamma_0 VD + \gamma_P X_{it}^{P} + \gamma_T X_{it}^{T} + \eta_{it} \quad (6)$$

The variable η_{it} in (6) is a vector of error terms, γ_P reflects the impact of X_{it}^{P} on savings through its effect on permanent income, and γ_T measures the impact of transitory variables on savings. γ_o captures the village effects. The key restriction derived from the PIH is that $\gamma_T = \beta_T$. The more complete the financial markets are, the closer γ_T is to one. The effects of the elements of X_{it}^{T} on savings are also expected to be identical to their effect on income. That is, transitory shocks should affect income and savings in an identical manner and X_{it}^{T} variables should have no effect on consumption. Positive and significant γ_T or a finding in favor of the PIH would indicate that households save in anticipation to future changes in income. Similarly, the hypothesis that the propensity to save out of permanent income should not be significantly different from zero (i.e. $\gamma_P = 0$) implies that all variables in X_{it}^{P} should have no effects on savings. Such variables should strictly be only those that are not collinear with LC_{it}. However, it may be difficult to find such variables, especially with only a few cross-sections of about a year and half. For instance, the value of assets is likely to be correlated with age. Indeed, we find age of the household head to be negatively correlated with education and cannot be considered independent (Spearman's rho = -0.30) at 1 percent significance level. To avoid simultaneity between current income and assets, only the value of those assets acquired three or more years before the first round survey are used.

An instrumental variable estimation is used to estimate the marginal propensity to save out of transitory income. The instruments for transitory income include percent rainfall shortfall, the crop loss index and days of work lost due to ill-health. The assumption made is that rainfall shortage and crop loss affect transitory income only, not permanent income. However, the assumption does not hold for ill health. Ill-health in the current period, especially when associated with HIV/AIDS, can affect permanent income. So, health variables also enter the second-stage estimation. The instrumental variable estimations are also used to check the validity of the reduced form results.

Calculation of income, saving and consumption

Total household income was estimated as a sum of household earnings from farming activities, wage, business, transfers and rents. The savings measures are derived from the investment behaviour. Savings was defined as reported purchases minus sales of assets and cash savings. We also included expenditure on consumer durables in each survey period. Consumer durables like furniture or clothing provide services over several years or at least several seasons and so allow current income to contribute to future utility. Paxson notes that computing savings in this manner may have serious problems if purchases and sales of farm animals and equipment are not explicitly measured. This problem was minimized in this survey as extra effort was made to record all the household purchases three months prior to each survey. In the first round of survey, retrospective data was collected for 6 months and one year period. Computing savings as the observed savings has the advantage of being uncorrelated with errors in estimated income. Although the respondents were assured of the confidentiality of the information provided, cash savings may have been underestimated if the savings are in unrecorded form. Consumption consists of expenditure on food plus expenditure on non-food including health care. Expenditure on food was constructed from purchased foods and imputed values of home production and informal transfers/gifts.

3. Results

This section presents three sets of results. The descriptive statistics are first presented. Estimates for both the reduced form and structural equations are then discussed in sections 3.2 and 3.3. The results are presented for each season.

3.1 Descriptive statistics

Table 1 provides the means and variability of household per capita consumption. A differentiation was made for AIDS-affected and non-affected households. Mean consumption was estimated at about KSh.1,961 (US$ 26.14) per adult equivalent per month. This mean is roughly consistent with the rural average of KSh. 1,836 per month (GOK, 2000) and KSh. 2144 (KNBS, 2007). Although affected households have higher food and non-food consumption than non-affected, their consumption is more volatile. This volatility is significant as depicted in Table 2.

Table 1 Mean and variability of monthly per capita consumption, income and savings by season and HIV/AIDS status

	Season 1 (2003/04 short rains)		Season 2 (2004 long rains)		Season 3 (2003/04 short rains)	
	Affected	Non-affected	Affected	Non-affected	Affected	Non-affected
Food consumption[1]	1180	1071	1188	1031	941	851
	(0.75)[2]	(0.62)	(0.54)	(0.51)	(0.67)	(0.52)
Non-food	973	777	992	616	1291	806
consumption	(1.52)	(1.09)	(1.21)	(1.46)	(2.64)	(1.41)
Total consumption	2153	1849	2079	1647	2200	1656
	(0.85)	(0.73)	(0.70)	(0.73)	(1.18)	(0.87)
Income	5085	5827	5124	5227	5877	5940
	(0.48)	(0.55)	(0.86)	(0.58)	(0.80)	(0.54)
Savings	13034	13569	5101	5479	6903	6300
	(0.59)	(0.61)	(0.84)	(0.80)	(0.67)	(0.71)
N	97	95	88	84	88	84

[1]Consumption in Kenya Shillings (KSh): 1 US$ ≈ KSh. 75 in 2004/05.
[2]Coefficient of variation in parentheses.

Table 2: Consumption mobility index for the three survey seasons

	Seasons 1–2			Seasons 2–3			Seasons 1-3		
Shorrock's Index	Affected	Non-affected	All	Affected	Non-affected	All	Affected	Non-affected	All
	0.72	0.59	0.64	0.72	0.52	0.64	0.65	0.54	0.59
H_0:Random transition χ^2			109.90**			69.65**			113**

*** Significant 1%

Table 2 presents transition probabilities across consumption quantiles using the Shorrock index as the measure of consumption mobility (Shorrocks, 1978). The table reveals substantial mobility across the three seasons. The Anderson and Goodman (1957) random transition χ^2 statistic rejects that the transition between quantiles are by chance. Close to 60 percent of the households move between consumption quantiles from season to season. Higher mobility is observed for AIDS-affected households as would be expected for shocks affecting permanent income. For instance, between the first two seasons, only 28 percent of AIDS-affected remained in their first season's quantile compared to 41 percent of the non-affected households.

The above mobility in consumption can be linked to shocks experienced by the households. Information on shocks is presented in Table 3. The table shows the severity of crop and livestock losses reported by the households in the three seasons. The most reported loss is crop loss due to insufficient rainfall: this was reported by about 55 percent of the households. This loss was most severe in the long rains season; with 64 percent of households reported such a loss. Very few households (about 10 percent) reported other losses. The table also shows the percent rainfall deviation. Since the survey period was generally drier than normal, the variable is regarded as percent rainfall shortfall. The weeding season, which also represents the plant growth phase, was much drier in all the survey rounds with the long rains season being the driest. The magnitudes of the computed indices are better depicted in Figure 1. For most of the reported cases of loss, the AIDS-affected households reported on average higher severity than the non-affected in all the seasons suggesting that they may be more sensitive to shocks. More male spouses reported more work days lost due to illness than female spouses in all seasons.

Although rainfall shock and thus crop loss was most severe during the long rains season, Figure 2 shows that, apart from households in the upper two deciles of consumption, welfare was generally higher during this season. This may be expected given this is the main harvest season. However, the effects of the poor harvest in this season are felt in the subsequent minor cropping season. Welfare level is lowest for all households during the third survey period. This large decline is consumption may be a signal that households are not able to insure consumption against seasonal shocks. We turn to the regression results to establish the extent to which consumption smoothing takes place through accumulation of savings.

Table 3 Means and standard deviations of income and health shocks

	Season 1		Season 2		Season 3	
	Affected	Non-affected	Affected	Non-affected	Affected	Non-affected
Index of Severity of Crop and Livestock losses						
Crop loss due to rain shortfall	1.60 (1.48)	1.4 (1.42)	1.94 (1.56)	2.09 (1.38)	0.98 (1.37)	0.76 (1.24)
Crop loss due to pests & diseases	0.46 (1.05)	0.33 (0.85)	0.05 (0.38)	0.04 (0.29)	0.26 (0.79)	0.23 (0.74)
Livestock death	0.50 (1.16)	0.62 (1.2)	0.18 (0.75)	0.19 (0.79)	0.10 (0.50)	0.14 (0.60)
Livestock illness	0.31 (0.91)	0.28 (0.75)	0.12 (0.65)	0.03 (0.31)	0.04 (0.29)	0.02 (0.21)
Health variables						
Work days lost by wife due to illness	2.55 (6.99)	1.65 (5.87)	2.37 (6.59)	1.62 (5.43)	2.82 (7.07)	1.10 (3.95)
Work days lost by husband due to illness	6.99 (11.78)	3.53 (7.92)	4.55 (8.54)	2.50 (6.13)	4.43 (9.21)	1.68 (5.10)
Rainfall shock						
% rainfall shortfall: planting season	0.25 (23.15)		-17.89 (25.72)		-9.55 (18.20)	
% rainfall shortfall:weeding season	36.67 (33.08)		53.18 (19.00)		6.11 (0.62)	

Standard deviation in parenthesis

Figure 1: Computed indices for severity of shock

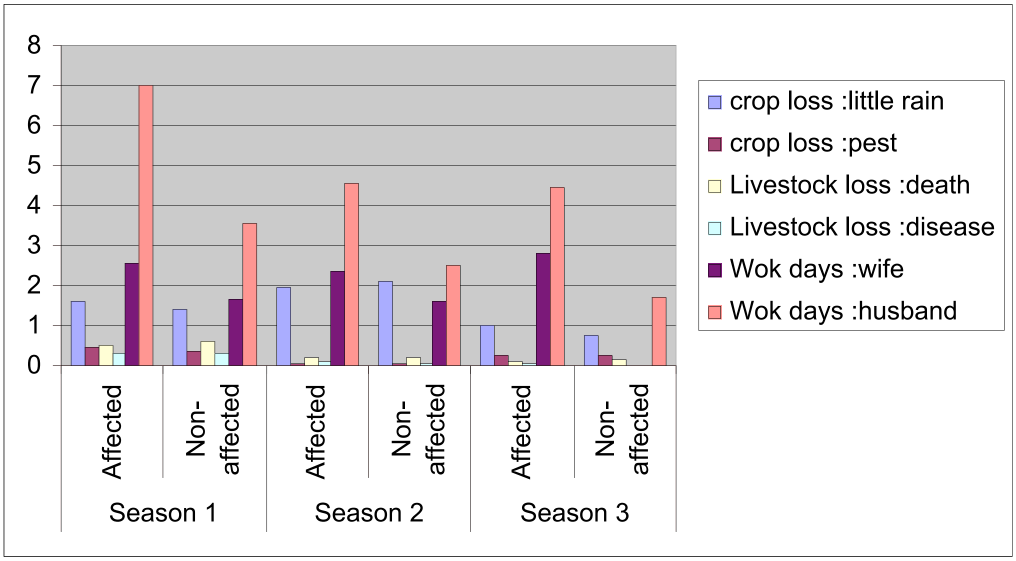
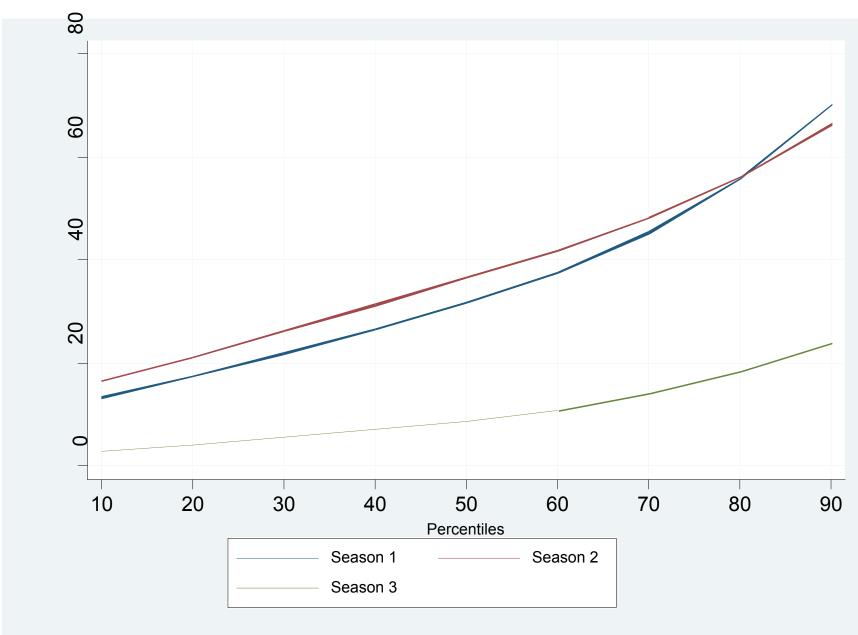


Figure 2: Welfare decline due to shocks



3.2 Do households use savings to smooth consumption across seasons

3.2.1 Reduced form income and savings estimates

The reduced form equations test the extent to which households use savings to insulate consumption against shocks across seasons. According to the permanent income hypothesis

(PIH), if households use savings to smooth consumption, the effect of transitory variables on income should be equivalent to their effect on savings and that there should be no significant effect on consumption. The test results are presented at the bottom of Table 4 for each season. Test 1 shows the significance of the rainfall variables. The test rejects the hypothesis that the effects of rainfall variables are jointly equal to zero in both the savings and income equations for all three seasons. In particular, rainfall shortage at planting time is significant in all the estimations. For example, during the first period, a 1 percent rainfall shortfall from its mean at planting time results in loss of income of about KSh. 28 and a dissaving of about KSh. 41. This reduction in savings is substantial given the daily wage for hired farm labour was about KSh.90 (US$ 1.20). At a mean rainfall shortfall of 25 percent, this translates to a dissaving of about Ksh. 1050, or close to two weeks' earnings.

Table 4 Reduced form estimates for per capita income and per capita savings equations for the three seasons (Seemingly Unrelated Regression)

Variables	Season 1		Season 2		Season 3	
	Income	Savings	Income	Savings	Income	Savings
	Coefficient (z-value)					
# aged < 6	-209.02 (-0.75)	-425.83 (-1.41)	-.426.69 (-1.05)	314.67 (1.02)	-542.34 (-94)	64.84 (0.23)
# aged 6–14	-427.49 (-2.88)	-399.60 (-2.48)	-202.62 (-0.87)	-298.60 (-1.71)	-228.27 (-0.78)	-238.97 (-1.60)
# aged 15–17	-492.81 (-1.17)	-728.82 (-1.59)	-156.97 (-0.22)	-134.51 (-0.25)		
# aged > 65	-2030.48 (-3.45)	-1561.68 (-2.45)	309.04 (0.36)	752.67 (1.16)	-241.77 (0.21)	-127.01 (-0.22)
# males aged 18–64	-145.62 (-0.93)	-293.58 (-1.73)	-276.29 (-1.31)	22.91 (0.13)	-338.03 (-1.01)	-220.42 (-1.34)
# females aged 18–64	-445.27 (-1.14)	580.71 (1.35)	-342.71 (-0.66)	-421.70 (-1.09)	-338.03 (-0.60)	162.47 (0.58)
Average education male 18–64	25.91 (0.33)	-41.23 (-0.48)	96.44 (1.31)	-84.04 -(0.90)	392.93 (1.78)	141.0 (1.66)
Average education female 18–64	-108.35 (-1.21)	105.75 (1.10)	163.86 (1.31)	44.47 (0.47)	316.48 (2.37)	117.30 (1.34)
Log Asset	177.35 (0.84)	509.21 (2.24)	488.20 (1.59)	3485.21 (1.74)	545.56 (1.31)	690.12 (3.28)
Log Land	936.62	606.34	575.14	811.85	1059.47	116.14

	(3.07)	(1.83)	(1.71)	(3.00)	(1.64)	(0.34)
Ill days	-3.24	-20.25	8.89	6.68	-20.06	-11.33
	(-0.15)	(-0.87)	(0.96)	(0.95)	(-0.62)	(-0.46)
HIV*ill days	-12.17	-20.76	-48.55	-67.80	-2.97	-11.33
	(-0.04)	(-0.64)	(-1.41)	(-2.58)	(-0.06)	(0.34)
Crop loss index	-387.94	-454.13	-595.14	-152.62	-1167.71	-574.23
	(-2.49)	(-2.66)	(-2.75)	(-0.94)	(-2.62)	(-2.54)
% rainfall shortfall planting	-28.50 (-2.78)	-41.35 (-3.05)	-48.57 (-3.13)	-34.70 (-2.94)	- 110.80 (-2.00)	-34.57 (-2.39)
% rainfall shortfall weeding	-21.14 (-1.14)	-10.15 (-0.35)	-23.55 (-1.82)	-23.22 (2.15)	-14.45 (-0.28)	-18.74 (-0.85)
N	182	182	166		169	
χ^2	70.61	87.60	48.98	46.61	43.04	57.80
R^2	0.28	0.32	0.23	0.21	0.20	0.25
Hypothesis Tests χ^2 (P-value)*						
Test1	7.84(0.02)	10.94 (0.01)	9.83 (0.007)	10.21 (0.01)	5.29(0.07)	5.71(0.06)
Test2						
(a)	0.94(0.62)		1.26(0.53)		3.57 (0.17)	
(b)	0.19 (0.66)		5.06 (0.02		2.23 (0.14)	
Test3		8.40(0.02)		9.18 (0.01)		11.68(.003)

*Hypothesis tests

Test 1: The rainfall variables are jointly equal to zero

Test 2: ($\gamma_T = \beta_T$)

(a) The effect of the rainfall variables on income is the same as the effect on saving

(b) The effect of crop-loss index on income is the same as the effect on saving

Test 3: The joint effect of assets and land on savings is equal to zero ($\gamma_P = 0$).

Test 2(a) tests for the equality of the effect of transitory rainfall shock on income and savings. The tests lead to acceptance of the hypothesis that the effect of the transitory rainfall variables on income is identical to their effect on savings in all the three seasons. Although equality of coefficients of the rainfall variables in the savings and income equations cannot be rejected, the PIH effect may be a weak one, given the significant adverse effect of low precipitation at planting time on consumption in all the three seasons (Table 5). Even though households show some prudence, the significant effect on consumption suggests that households are unable to completely buffer consumption across seasons against income rainfall shock.

Test 2 (b) does not reject equality of the effects of household-specific crop loss on savings and income for first and third seasons. This hypothesis would be expected to hold since households observe the crops grow and would therefore be expected to make better judgment on crop outcome and prepare accordingly. However, the second season is inconsistent with this argument. Crop loss has no significant effect on saving leading to rejection of the PIH for this long-rain season. Evidence that seasonality does impact on the precautionary behaviour can also be deduced from the fact that the level at which the null of PIH is accepted in the third season is at the margin (p-value=0.14) compared to the first season (P-value=0.66). Similarly, in Test 1(a) the level of acceptance for PIH for the rainfall variables also declines between seasons 1 and 3.

Another implication of the PIH is that savings are unrelated to permanent income. This relationship implies that after controlling for life-cycle effects, the permanent income variables such as land ownership and other assets should have zero impact on savings. The results presented as Test 3 do not support such an assertion for any of the seasons. The asset ownership variables are jointly significant. Land size and other assets are positively related to savings, suggesting that households with more assets save even more.

Table 5 Log per capita food consumption

Variables	Season 1	Season 2	Season 3
	Coefficient (z-value)		
# aged <6	-0.06	-0.05	-0.08
	(-1.01)	(-0.83)	(-1.24)
# aged 6–14	-0.10	-0.08	-0.20
	(-3.10)	(-2.26)	(-5.27)
# aged 15–17	-0.20	-0.20	-0.15
	(-2.11)	(-1.76)	(-2.05)
# aged > 65	-0.29	-0.12	-0.30
	(-2.14)	(-0.89)	(-2.42)
# males aged 18–64	-0.06	-0.10	-0.28
	(-2.00)	(-2.83)	(-7.07)
# females aged 18–64	-0.11	-0.08	-0.20
	(-1.26)	(-0.99)	(-2.82)
Average education male	-0.02	0.01	
aged 18-64	(-1.25)	(0.30)	
Average education	-0.02	0.01	
female aged 18–64	(-1.25)	(0.31)	
Log Asset	0.21	0.16	0.05
	(4.52)	(3.53)	(0.99)
Log Land	0.05	0.04	0.03
	(0.70)	(0.73)	(0.31)
Ill days	-0.01	-0.0003	-0.01
	(-2.74)	(-0.22)	(-2.58)
HIV *ill days	0.02	0.01	0.01
	(2.49)	(1.05)	(2.30)
Crop loss index	-0.08	-0.01	-0.16
	(-2.39)	(-0.15)	(-2.85)
% rainfall shortfall	-0.01	-0.53	-0.84
planting	(-3.15)	(-2.19)	(-2.27)
% rainfall shortfall	0.0003	-0.17	0.19
weeding	(0.10)	(-0.95)	(0.33)
N	182	166	169
χ^2	112.16	64.40	144.60
R^2	0.38	0.29	0.46
*Test χ^2 (P-value)	10.67 (0.005)	4.84 (0.09)	6.77 (0.03)

**The rainfall variables are jointly equal to zero*

The demographic variables in Table 3 do not show a strong and consistent pattern between savings and age structure, as well as sex. The signs of the coefficients are mixed across the equations. However, where significant in the first season, they are consistent with the theory: households with more elderly members and young children save less.

Turning to the health variables, although the coefficients for being ill and AIDS-affected are negative, only the second season's effect on savings is significant. From Table 5, being AIDS-affected and ill is positively related to per capita food expenditure. The positive effect can be explained by the fact that there may be greater need to maintain good nutritional status for HIV patients. This results go against previous predictions that "…AIDS medical costs will be met by reducing both consumption and savings in a balanced manner, and not necessarily be drawn disproportionately from own savings" (Bloom and Mahal, 1997: pg. 109). The rise in consumption and the negative effect on savings may be a signal that the relationship is likely to be disproportionate.

3.3 Results of the structural equation: propensity to save out of transitory income

The instrumental variable results for equation 5 fail to agree with the reduced form estimates in that they lead to a rejection of the PIH (Table 6). However, the results agree with the observation made earlier that the PIH effect is weak in the sense that consumption is affected Households do not save as much of their transitory income as the PIH would predict. The average propensity to save out of transitory income for the three seasons is about 0.33. These findings are close to Ersado *et al*. (2003), who finds a propensity to save out transitory income of 0.36 for rural Zimbabwe, but differ from that of Paxson (1992), who finds households save a large proportion of their transitory income (0.78–0.83). The Thai households examined by Paxson were much wealthier (middle-income category) than those examined here and in Zimbabwe. In much poorer households, budgeting of transitory income would be expected to deviate substantially from the theoretical prediction that all transitory income is saved.

Rainfall uncertainty raises savings. In particular, the coefficients for planting season rainfall variability (CV) are all positive. When rainfall variation interacts with wealth, the first season suggests that farmers' precautionary balances may decline as the sign is negative and significant. Reduction of precautionary balances with wealth would suggest that poorer farmers face a higher premium for risk since they may hold more of their wealth in liquid form compared to wealthier ones. This would be in line with Rosenzweig and Binswanger (1993) results in rural India that show wealthier farmers to be less risk-averse. However, as the season deteriorates, the effect of CV interacting with wealth becomes insignificant, which may point to a vulnerable asset base, even for the better-off.

Table 6 Estimates for the structural equation for savings (Two-stage least squares regression)

Variables	Period 1	Period 2	Period 3
	Coefficient (z-value)		
Log per capita income	.35	.29	0.34
	(2.16)	(1.66)	(2.55)
# aged < 6	-1308.73	489.04	
	(-1.88)	(1.75)	
# aged 6–14	-682.62	-144.97	-86.69
	(-1.57)	(-0.79)	(-0.70)
# aged 15–17	1572.34	-175.85	353.46
	(1.08)	(-0.42)	(1.54)
# aged > 65	-872.29	959.80	
	(-0.49)	(1.79)	
# males aged 18–64	-280.30	147.32	-234.84
	(-.71)	(0.71)	(-2.14)
# females aged 18–64	3490.94	-147.32	
	(3.17)	(-0.44)	
Education head	269.61	-107.67	68.14
	(1.13)	(1.12)	(0.72)
Log asset	1584.69	3114.11	771.86
	(2.56)	(1.51)	(3.16)
Log asset squared		-180.44	
		(1.78)	
Log land	1900.32	699.50	266.34
	(1.81)	(2.77)	(1.20)
Ill days	1953.31	-54.48	-17.14
	(1.53)	(-2.78)	(-0.96)
HIV/AIDS dummy	-2281.12	-304.71	633.09
	(-1.71)	(0.52)	(1.42)
HIV/AIDS dummy wealth	-203.68	-416.16	-556.28
	(-0.97)	(-1.11)	(-1.04)
CV planting	6204.74	2897.19	3144.89
	(1.04)	(0.39)	(2.50)
CV planting wealth	-6516.79	512.26	-220.43
	(-2.18)	(0.65)	(-0.56)
Constant	-1886.12	14003.06	-10369.36
	(-2.27)	(1.22)	(-3.60)
N	177	166	169
F	5.18	2.37	8.11
R^2	0.26	0.40	0.31
Anderson canon. LR statistics	95.78 (p value=0.000)		8.55 (p value=0.04)
Hansen J statistic	0.04 (p value=0.85)		0.38(p value=0.82)

4. Conclusions

This paper investigates the extent to which households build buffers to insulate consumption against seasonal shocks. It entailed examining seasonal changes in saving behaviour and testing the ideas that that people save most of their transitory income as permanent income hypothesis postulates. The results show that while households exhibit some level of prudence, the extent to which they save out of transitory income deviates from unity as the theory postulates. About 33 percent of the transitory income is saved in each season. This also shows the extent of incompleteness of financial markets in the study area. The implication is that households are not able to use savings and credit to smooth consumption across seasons.

The results show seasonality to influence level of prudence. Households appear to exhibit low risk management and precautionary motives in more stressful seasons as dependency on transitory income for consumption rises. Although wealth negatively influences precautionary balance, the asset base seems quite vulnerable since the wealth effect becomes insignificant as the seasons deteriorate.

The presence of HIV/AIDS increases per capita consumption which would imply depressed savings. While a decline in savings would jeopardise future investments, the rise in consumption when the human asset is threatened is in accordance with the behaviour of forward-looking agents when future income is dependent on current asset shock (Barrett and McPeak, 2005). The desire to smooth the asset (improve health) may outweigh the desire (or the ability) to smooth future consumption through increased savings. As a consequence, consumption across seasons would tend to be relatively volatile.

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